U. S. FOREST SERVICE
RESEARCH NOTE PSW- 54

PACIFIC SOUTHWEST
FOREST & RANGE EXPERIMENT STATION
Berkeley, California 1964

INTERMOUNTAIN STATION
Ce... Research Files
No. 0.73

Adventitious Rooting — A Response to Hawaii's Environment

RONALD M. LANNER

ABSTRACT: Adventitious roots have been seen on trunks or limbs of eight species of exotic forest trees in Hawaii. In their native habitats these species either do not form such roots, or form them rarely. These roots possess no adaptations to protect them against drying out, and can survive only under extreme humidity.

Adventitious roots have been observed on several species of exotic trees planted in the forests of Hawaii. Their pattern of occurrence leaves little doubt these roots develop on aerial portions of the trees in response to high humidity of the air and to the substrates upon which the roots grow. The species considered here are not among those in which adventitious rooting is the common growth habit—as in certain species of Ficus, Metrosideros, and Broussaia. Rather they are species in which such rooting is rare or unknown in the native habitat.

Swamp-mahogany eucalyptus (Eucalyptus robusta Sm.). — This Australian eucalypt—widely planted in Hawaii for many years —is the species in which adventitious roots are most common and conspicuous. The roots appear most often on trees growing in areas of high rainfall or where frequent fog keeps the bark moist. The roots normally grow within the fibrous wet bark, and apparently cannot tolerate the drying conditions of the open air except for short periods. Tree form and spacing influence the formation of these roots by affecting the concentration of stemflow on certain sectors of the trunks and large branches. These factors are described in detail elsewhere.[1]

Paperbark (Melaleuca leucadendron L.). --One tree of this species growing at Waikoekoe, Hawaii, had several roots emerging

[1]Lanner, Ronald M. Adventitious roots of *Eucalyptus robusta* in Hawaii. 1964. (Manuscript submitted to Pacific Science).

LIBRARY FILE COPY

from the trunk at about breast height. These were growing downwards, entirely within the bark, as in swamp-mahogany eucalyptus. The thick bark, made up of many thin paper-like layers, was saturated with water that had probably entered through an injury some feet up the trunk.

Sugi (Cryptomeria japonica (L. f) Don.). —In a plantation of this Japanese conifer at Poli Poli, Maui, numerous short roots were seen projecting from the trunk within a few feet of the ground. Many of these roots grew within the bark until they contacted the soil at the base of the tree. Despite the high humidity and heavy fog drip here, most roots that had grown through the bark and into the open air had died back.

Nepal alder (Alnus nepalensis Don.) and red alder (Alnus rubra Bong.).—In the rainy, foggy Kohala Mountains on the island of Hawaii, fine aerial roots commonly grow down the trunks of Nepal alders, whose native habitat is in the Himalaya. The role of such roots in formation of clones from windthrown trees has been described elsewhere.[2] Many of the adventitious roots end in compact and highly-branched clusters of atrophied roots that dangle upon the trunk. These roots appear morphologically similar to the "nitrogen collecting root nodules of the Alder" pictured by Büsgen and Münch.[3] Perhaps the roots least subject to drying are those that descend along a sector of the trunk covered with wet mosses. Wardle[4] has noted the frequent association of adventitious roots and mossy trunks on Nothofagus menziesii in New Zealand.

A single red alder tree at Poli Poli, Maui, had roots similar to those of Nepal alder growing downwards along the trunk.

Mexican ash (Fraxinus uhdei (Wenzig) Lingelsheim. —Adventitious roots have been seen on a specimen of this commonly planted tree in the Waiakea Forest Reserve, Hawaii, where annual rainfall is about 200 inches. The tree had been planted in a hole so that the lower portion of its trunk was in a shaded declivity surrounded by vegetation. Rooting was from this protected part of the tree, about half a foot above the root collar. According to G. B. Richmond, U. S. Forest Service, Hilo, Hawaii, short adventitious roots are common on the lower trunks of ashes in the Honaunau Forest, Hawaii. Most of these die before reaching a length of 1 inch.

Ironwood (Casuarina cunninghamiana Miquel. and C. littoralis). — These Australian species produce short, stiff aerial roots in the Waiakea Arboretum in Hilo, Hawaii.[5] The effect of a moist microenvironment is especially well seen in C. cunninghamiana. Here the roots project, whisker-like, from the base of the tree to about 8 feet above the ground.

---

[2]Lanner, Ronald M. Clones of Nepal alder in Hawaii. Jour. Forestry 62(9): 636-637, illus. 1964.

[3]Büsgen, M., and Münch, E. The structure and life of Forest Trees. 436 pp. Engl. transl. by T. Thomson. New York: John Wiley & Sons. 1929.

[4]Wardle, P. Growth habits of New Zealand subalpine shrubs and trees. N. Z. Jour. Botany 1(1):18-47, illus. 1963.

[5]Richmond, G. B. Species trials at the Waiakea Arboretum, Hilo, Hawaii. U.S. Forest Serv. Res. Paper PSW-4, 21 pp., illus. Pacific SW. Forest & Range Expt. Sta., Berkeley, Calif. 1963.

Farther above the ground, the roots become fewer and noticeably shorter; a higher proportion of them are dead. Near the base, roots are more robust, and many of them enter the soil. The understory of herbaceous weeds and woody shrubs is dense at the heights at which most of the roots emerge, but above 8 feet there is little understory vegetation to restrict air movement and provide shade.

Roots of C. littoralis appear to emerge only from the basal part of the trunk, just above the root collar.

Most of these eight species are rather obscure even in their native lands, and there is a paucity of published information on their silvical habits. According to foresters and botanists familiar with them, in the species described here either do not produce adventitious roots at all, or such rooting is much rarer than in Hawaii.[6]

The dependence of these roots on highly humid environmental conditions, so pronounced as to restrict several of the species to within-bark rooting, suggests that these trees have either never been adapted to adventitious rooting in drier environments, or that they have lost any adaptations they may have had. This is in contrast to adventitious rooting in Ficus, Broussaia, and Metrosideros, in which special adaptations probably permit young aerial roots to survive despite occasional or even frequent dry spells. As more of the exotic trees growing in Hawaii receive greater attention, adventitious aerial roots will probably be found in other species in which this growth habit is presently unknown.

The Author...

RONALD M. LANNER, formerly on the Pacific Southwest Station's silvicultural research staff in Hilo, Hawaii, is now at the School of Forestry, University of Minnesota, St. Paul, Minnesota.

[6]Personal correspondence with N. P. Worthington, Pacific NW. Forest & Range Expt. Sta., U.S. Forest Service, Portland, Ore. Jan. 6, 1964; Yoshitada Kato, Government Forest Experiment Station, Ministry of Agriculture, Tokyo, Japan, Feb. 4, 1964; M. R. Jacobs, Forestry and Timber Bureau, Canberra, Australia, Sept. 23, 1963 and Jan. 15, 1964. No information was forthcoming on Nepal alder or Mexican ash.